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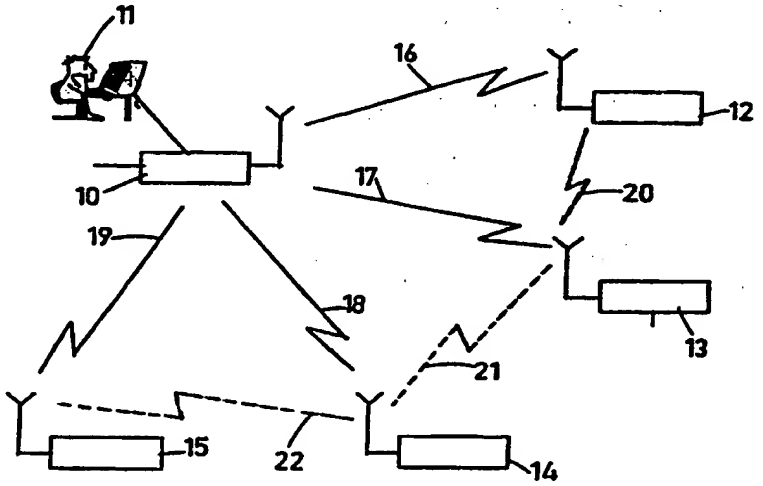

(57) Abstract

Survivable wireless network, such as a ring network, that comprises a main Hub (10) with an array of transmitters and an array of receivers, a plurality of Sites (12–15), each Site comprising a transmitter and a receiver and at least two communication paths (16–22) for transmission of information between the main Hub and each Site. Several communication paths are working paths (16–19) and other communication paths function as protection paths (20–22), with switching means for switching from one communication path to another. Each communication path comprises at least one two–way wireless link. The network further comprises working links (16–19) between the Hub (10) and at least two of the Sites (12–15) and protection links (20–22) connecting a number of the Sites to one another. The means for switching traffic from one another of the communication paths comprise means for switching traffic from a path defined by a working link to a path defined by the combination of another working link with at least one protection link, or defined by a plurality of protection links, or from a path defined by the combination of a working link with at least one protection link to a path defined by another such combination, or defined by a plurality of protection links.

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MESHED WIRELESS NETWORKS

Field of the Invention

This invention refers to managed survivable wireless networks, viz. wireless networks that are capable of operating even after failures have occurred in links between their stations. The networks of the invention also provide a high efficiency and quality of service under variable operating conditions.

Background of the Invention

Network survivability, viz. the capability of a network to continue operating in spite of a failure or near-failure, such as a substantial drop in transmission quality, in one or more of the links comprised in the network, is a desirable feature of wireless networks, particularly modern transmission networks, especially after the introduction of the Synchronous Optical Networks (SONET)/Synchronous Digital Hierarchy (SDH) Networks, which incorporates a self-healing network architecture The art, however, does not provide an effective solution for radio networks, such as cellular telephone networks or other networks transmitting different kinds of information by way of radio links.

The most common configuration in a multi-point fixed radio environment is a logical Star configuration, which typically comprises a main Hub and a plurality of Remote Terminals (RT) or Sites, as they will generally be called hereinafter. The main Hub, which includes a Central control Office (CO), which in turn contains the main switch, is composed of an array of transmitters and an array of receivers. The RTs or Sites, on the contrary, are equipped with a single transmitter and a single receiver. The main Hub is directly connected to each RT by a link or channel - hereinafter "working"

or "main" link. In radio communication, a link or channel (these two terms should be considered herein as synonymous, is defined by a frequency or a very narrow band of frequencies, which means that each RT or Site is characterized by the frequency or narrow band assigned to it, whereas the main Hub can transmit and receive over all the frequencies of a very wide band. In a conventional Star configuration, in case of failure or near-failure of one of the working links, the corresponding RT ceases to be operative. This is a common experience in the case of cellular telephones, where a subscriber may be unable to communicate with the other subscribers, even though his apparatus and all the apparatuses are unimpaired, because the radio channel between his apparatus and the main Hub or central station is unusable, due, e.g., to topographical or other reasons.

It is a purpose of this invention to provide a survivable radio network which maintains the communication between its RTs and the Hub, even when one or more working links between the Hub and the RTs cease to be operative or are not operative with the necessary quality.

It is another purpose of this invention to provide such a network which comprises additional communication paths, or routes, between its RTs and its Hub, besides the working links.

It is a further purpose of this invention to provide such a network in which the means for assuring its survival are also used to carry extra traffic.

It is a still further purpose of the invention to provide means in such a network for directing the information, that needs to be transmitted, over a

protection path or route, if the ordinary path, constituted by a working link, ceases to be operative.

It is a still further purpose of the invention to provide such a survivable network which comprises a wireless Broadband Integrated Services Digital Network (B-ISDN) access.

It is a still further purpose of the invention to provide a survivable network which can be operatively connected to other similar networks.

It is a still further purpose of the invention to provide a survivable network which can be integrated into the Groupe Special Mobile (GSM).

It is a still further purpose of this invention to provide various network architectures for the GSM.

It is a still further purpose of this invention to provide survivable wireless communication systems comprising a plurality of survivable wireless networks.

Other purposes and advantages of the invention will appear as the description proceeds.

Summary of the Invention

The invention provides a wireless network which comprises:

I - a Hub comprising a transmitter array and a receiver array;

II - a plurality of Sites or RTs, or subscriber apparatus, each comprising a transmitter and a receiver; and

II - at least two communication paths, or routes, between said main Hub and each of said Sites.

Preferably, the network comprises means for switching traffic from one to another of said communication paths or routes.

Herein, the term "path" indicates the route by which a signal travels between the point at which it has been sent and the point at which it has been received. A path may be constituted by a single link or channel, viz. be a direct path between a transmitter and a receiver, or by a succession of links or channels which convey the signal from the transmitter to the receiver though one or more intermediate nodes, each of which receives the signal and retransmits it, the reception and transmission channels being generally different.

Preferably, the network according to the invention comprises:

A - working links between the Hub and at least two, optionally all, of the Sites;

B - protection links connecting a number, optionally all, of the Sites to one another; wherein

C - the means for switching traffic from one another of the communication paths comprise means for switching traffic a) from a path defined by a working link to a path defined by the combination of another working link with at least one protection link, or defined by a plurality of protection links, or b) from a path defined by the combination of a working link with at least one protection link to a path defined by another such combination, or defined by a plurality of protection links.

By "traffic" is meant herein the transmission of signals or information of any kind.

Preferably, the said means for switching traffic operate automatically in case of failure of a link comprised in a communication path.

In a preferred embodiment of the invention, the wireless network is a ring network comprising a plurality of Sites successively connected to one another by a plurality of links each connecting to Sites. Any one of the Sites can be considered a Hub and the remaining Sites can be considered RTs.

Also preferably, said protection links carry extra traffic, which are lost when the main traffic is switched to a path comprising said link.

In a variant of the invention, an ISDN link can be provided between the Hub and one of the Sites in any network or communication system as hereinbefore defined. Further, ISDN terminals can be provided at one or more Sites, to provide access of ISDN information into the network.

The invention also comprises a communication system, which comprises a plurality of networks, each as hereinbefore defined, and means for interconnecting the same. More preferably, means are also provided for using the extra capacity of at least one such network in case of crisis in the Hub of at least another such network. Further, one or more of such networks can be integrated into a broader communication system, such as GSM.

The invention further comprises a method of operating a survivable wireless network as hereinbefore defined, which comprises sending information over both working and protection paths and selecting at each Site for the best available path.

In an embodiment of the invention, said method comprises sending the main information over the working path, using the protection path to carry extras traffic, and selecting at each Site the best available path, and in case of failure, sending the main information over the protected path, while losing the extra traffic.

In a preferred embodiment of the invention, the wireless network is a ring network and is operated by sending information constantly in the two opposite directions and selecting at each Site the path that is best at the moment the information is received. More preferably, information is sent by the full bandwidth of the system and the relevant information is dropped at each Site.

Brief Description of the Drawings

In the drawings:

- Fig. 1 schematically illustrates a Multipoint Meshed Survivable Network, which, by way of illustration only, is represented as comprising 5 nodes: a Hub and 4 RTs;

- Fig. 2 schematically illustrates a point-to-multipoint Survivable Ring Network;

- Fig. 3 schematically illustrates a point-to-multipoint Survivable ISDN Network;

- Fig. 4 is a simplified GSM structure diagram;

- Figs. 5(a), 5(b), 5(c), 5(d), 5(e) schematically illustrate different network architectures for the GSM; and

- Fig. 6 schematically illustrates two combined Survivable Networks, each comprising a Base Station Controller (BSC) which controls a plurality(three in the drawing) of Base Transceiver Stations (BTS).

Detailed Description of Preferred Embodiments

Fig. 1 schematically illustrates a first embodiment of the invention, which is a Multipoint Meshed Survivable Network. Numeral 10 indicates the Hub, which includes a symbolically represented Network Management (NM) 11. Numerals 12, 13, 14 and 15 are four Sites or RTs. Hub 10 is connected to the aforesaid Sites, through working links respectively indicated at 16, 17, 18 and 19. Additionally, according to the invention, protective links (indicated by broken lines) are provided as follows: link 20 between Sites 12 and 13; link 21 between Sites 13 and 14; and link 22 between Sites 14 and 15. The working links as well as the protection links are two-way links.

It will be understood that, while four Sites are illustrated in the drawing, in practice the number of Sites will be higher and often very high.

The said network is controlled by the NM 11 at the Hub. The network's status is conveyed to the NM by Operation and Maintenance (OAM) channels from the RT Site's local controllers via the working and protection links. Any one or more than one of the main or working links, 16, 17, 18 and 19, may cease to operate, or the quality of service (QOS) associated with it may become degraded. These phenomena can be sensed and identified by means known to a person skilled in the art. For instance, the carrier band which carries the signal over one of the working links, may cease to be

transmitted, in which case the link is totally interrupted; or the noise over the carrier wave may become too high to permit good modulation and therefore, efficient transmission of the signal. When one of these phenomena is detected, the NM at the Hub will cause a new communication path to become operative to transmit the main information, instead of the original path defined by a failed working link. The new path will be defined by the combination or succession of an efficient working link and one or more protection links. The information that is to be transmitted to a first Site, which can no longer be reached efficiently through the corresponding working link, because of the failure of degraded functionality of this latter, is transmitted to a second Site, preferably one of the Sites near to said first Site, via the corresponding working link, together with an instruction to said second Site to retransmit the information via a protection link to said first Site, to which it is destined. The reverse is also true: information from said first Site can be transmitted to said second Site, via the same protection link, together with an instruction to said second Site to retransmit the information to the Hub via its working link. For instance, if working link 18 should be interrupted or cease to operate efficiently, so that direct communication of information from the Hub to Site 14, and vice versa, is no longer possible, information can be sent by the Hub via a survival path constituted by working link 19 and a protection link, specifically, in the case illustrated, via working link 19 to Site 15, and from Site 15, over protection link 22, to Site 14; or it can be sent via another survival path, viz. via working link 17 to Site 13, and from Site 13, over protection link 21, to Site 14. All the links being two-sided, the same communication paths will permit Site 14 to transmit information to the Hub. The action of the NM will be manual, or preferably automatic, viz. determined by reception at the NM of a signal indicating the loss or

degraded quality of signal over a working link (18, in the case exemplified), which signal will be received at the relevant Site (14, in the case exemplified), as well. Since alternative survival paths are available, the local controller at said relevant Site will select the one that gives better results. In general, information is always transmitted in both directions, clockwise and anticlockwise. The terminals accept the best and coherent signal. The NM is constantly monitoring the signal and the selection is done by making sure that the signal have the best Bit Error Rate (BER), and, for coherency, in terms of weather or atmospheric conditions which are known to affect wireless signals at high RF frequencies, and therefore need different types of equalization, examples of which are "adaptive" or "blind" equalization to compensate. Moreover, there is strong correlation between data rate and equalization and also modulation techniques (viz. QPSK, 16 QAM, 64 QAM, etc.)

If the protective link used, e.g., link 31 or 22, was used to carry extra traffic, viz. to convey information of lesser priority than that of the main traffic, viz. that which is normally sent through the working links, this extra traffic will be lost when the Hub decides to activate a survival path which includes said protective link in order to transmit information to a Site which could not otherwise be reached, e.g., in the aforesaid example, to Site 14. This obviously occurs because the extra traffic is sent through the protection paths at a frequency which is slightly different from that assigned for signal transmission when the link is used as a protection link. The information sent at the abandoned frequency will therefore be lost.

Alternatively, in such a network, the information may be continuously sent over both the working and the survival paths. For instance, information to

Site 14 can be sent both through working link 18 or through working link 19 and protection link 22. In that case, the Site will select the path which is better in terms of noise, etc. This is permitted because the information is sent through working link 18 at a frequency and through protection path 22 at a different frequency, and therefore the two receptions can be compared and one of them selected

Fig. 2 illustrates another embodiment of the invention, which will be called herein "Point-to-multipoint Survivable Ring Network". Said network, differs from that of Fig. 1 in that the Sites are arranged, so to speak, in a succession, and links are provided from the Hub only to Sites that can be called "terminal". Thus, in Fig. 2, Hub 30, having an NM 31, is connected to Site 32 and Site 35 through working links 36 and 39, respectively. There are no working links between Hub 30 and Sites 33 and 34. Protection links 40, 41 and 42, are provided. Site 33 will receive information through working link 36 and protection link 40 or through working link 39 and protection links 42 and 43; and Site 34 will receive information through working link 39 and protection link 42, or through working link 36 and protection links 40 and 41. In this case, too, each Site will select the path which provides the best information. Since there are two routes of information to each Site, if one of the Sites leaves the network, e.g., when a cellular telephone is shifted to an area which cannot be reached by Hub 30, the network does not cease to operate, because the other route is still available. Thus, even if one of the two terminal Sites, e.g., Site 32, should leave the area covered by Hub 30, the remaining Sites will still receive information from working link 39 and protection links 42, 41 and 40. Likewise, if the working link between the Hub and a terminal Site should

be interrupted, that Site will still receive information through the other working link, and/or the intermediate protection links.

The ring operates in such a way that the information is circulated in both directions: each Site is really a Hub that has double RF units and Modems; or, in other words, a ring of a plurality of Sites is provided, comprising links each of which connects two successive or adjacent Sites, wherein each Site can be considered as the Hub. The ring is provided with means for sending the information in both directions at all times. Therefore, one cannot actually identify which path is a protection path and which is the main path. The essential concept is that the same information is circulated fully in both directions and at each node the best path is selected at the time the information is received. This system will support add/drop type communication, which will allow to utilize the full bandwidth of the system, while dropping the relevant information at each node as a multiple of E1/T1.

Fig. 3 illustrates a third embodiment of the invention, which will be called "ISDN BRI (Basic Rate Interface) multipoint Network". This provides a B-ISDN access. It includes a network such as illustrated in Fig. 1, with the addition of an ISDN link. An ISDN multiplexer 52 is provided at the NM 51 of the Hub 50, and is connected by a link 53 to another ISDN multiplexer 54, which is located at one of the Sites 55, 56, 57 and 58 - in the particular example shown by way of illustration, to Site 57. The aforesaid Sites are connected to the Hub 50 by working links 60 to 63 respectively, and protection links 64, 65 and 66 are provided between Sites, as in the preceding embodiments. It will be understood that the ISDN link provides an alternative route for transmitting information, which can reach any Site

through the protection links. ISDN terminal equipment units 67, 68, 69 are provided at the RTs that are not connected to ISDN link 53, to permit access of ISDN information through the RTs. The ISDN link provides an NT (Network Terminal) functionality, and a multiplexed voice/fax grade 3 can be carried over the ISDN link. The embodiment of Fig. 3 provides a Survivable Wireless ISDN Network which offers high-speed connection in a variety of quality and service grades for the shared protection capacity of the link, using the ISDN products which offer the best cost effective solution.

In this embodiment, the Site which is connected to the ISDN link, in this example, Site 57, can use an existing narrow band, (64 K, 128 K) leased line link, offering extra protection through the different routes which the network makes available.

The network of Fig. 3 can serve either as a wireless ISDN extension, or a private ISDN network which provides a gateway to the public ISDN network.

Fig. 4 illustrates another application of the invention, specifically, a survivable GSM network. Fig. 4 is a simplified GSM structure diagram, including embodiments of the invention. The Mobile Switching Center (MSC) can be connected to a Public Switch Telephone Network (PSTN) or an ISDN. The MSC in turn is connected to a plurality of Base Station Controllers (BSC), two in the case illustrated in Fig. 4. Each BSC is connected to a number of Base Transceiver Stations (BTS) - three for each BSC, in the embodiment of Fig. 4. E1 and T1 are standard types of bit rate communication. E1 = 2.048 MB/s is usually used in Europe and T1 = 1.54

MB/s is its equivalent in North America. As can be seen in the diagram, two of the BTSs are connected to a Management System (MS) which comprises message transfer terminal equipment (TE-MT).

Fig. 5 illustrates various possible architecture configurations for the GSM network. In the configuration of Fig. 5a (herein called "Combined Omni") the MSC is connected to a Base Station Controller (BSC) which in turn is coupled to a Base Transceiver Station (BTS). Another configuration, called herein "Combined Star", is illustrated in Fig. 5b, wherein the MSC is connected to a BSC, which in turn controls a number (three in the figure) of BTSs. In the Star configuration of Fig. 5c, the BSC controls a number of BTSs. In the configuration of Fig. 5d, herein called "urban Star", the BSC is directly coupled to three BTSs and controls three other BTSs through a link. Finally, in the configuration of Fig. 5e, herein called "urban Ring, the BSC directly controls the BTS and controls two more BTSs, one directly and one through the other BTS.

Fig. 6 schematically illustrates a simple case of a communication system which comprises a combination of networks embodying the invention - in the figure, for purposes of illustration, two networks. Two BSCs, indicated as 70 and 80, are provided. BSC 70 controls BTSs 72, 73 and 74 through working links 76, 77 and 78, the BTSs being connected by protection links 78 and 79. Similarly, BTS 80 controls BTSs 81, 82 and 83 through working links 84, 85 and 86, protection links 87 and 88 being provided between the BTSs. It is clear that the number of components indicated in Fig. 6 is only illustrative, and the various networks may comprise a different number of Sites or terminal stations. The two networks are connected by an additional protection link 90, which connects two BTSs, in the example, BTSs 73 and

83. A direct link could be provided between BSC 70 and BSC 80. The function of the protection links is the same as that explained with respect, e.g., to Fig. 1, but additionally, the protection link 90 connects to the two networks, so that the system may survive in case of the failure of one of the BSCs. While the network associated with each of the BSCs has been illustrated as a Meshed Survivable Network, as in Fig. 1, it could be constituted by a Multipoint Survivable Ring Network, as illustrated in Fig. 2. One or two of the networks could also be a Survivable ISDN Network, as illustrated in Fig. 3.

While a number of embodiments of the invention have been described for the purpose of illustration, it will be understood that the invention can be carried out by skilled persons with many modifications, variations and adaptations, without departing from its spirit or exceeding the scope of the claims.

CLAIMS

1. Survivable wireless network, which comprises:

a) - a main Hub, comprising an array of transmitters and an array of receivers;

b) - a plurality of Sites, each comprising a transmitter and a receiver; and

c) - at least two communication paths for transmission of information between said main Hub and each Site.

2. Wireless network according to claim 1, wherein the communication paths comprise working paths and protection paths.

3. Wireless network according to claim 1, wherein each communication path comprises at least one two-way wireless link.

4. Wireless network according to claim 1, comprising means for switching from one communication path to another.

5. Wireless network according to claim 1, which is a ring network comprising a plurality of Sites successively connected to one another by a plurality of links each connecting to Sites.

6. Wireless network according to claim 5, wherein one of the Sites is a Hub and the remaining Sites are RTs.

7. Wireless network according to claim 1, further comprising

e) - working links between the Hub and at least two of the Sites;

f) - protection links connecting a number of the Sites to one another; wherein

g) - the means for switching traffic from one another of the communication paths comprise means for switching traffic a) from a path defined by a working link to a path defined by the combination of another working link with at least one protection link, or defined by a plurality of protection links, or b) from a path defined by the combination of a working link with by at least one protection link to a path defined by another such combination, or defined by a plurality of protection links.

8. Wireless network according to claim 1, wherein the means for switching traffic from one to another of the paths are automatic means operating in case of failure of a working link.

9. Wireless network according to claim 3 or 4, wherein at least one protection link carries extra information, which is lost when the network switches to a protection path which comprises said link.

10. Wireless network according to claim 1, wherein the main information traffic is normally sent over working and protection links, and means are provided for choosing the better route.

11. Wireless network according to claim 5, comprising means for sending information constantly in the two opposite directions and means at each Site for selecting the path that is best at the moment the information is received.

12. Wireless network according to claim 5, comprising means for add/drop communication, whereby information is sent by the full bandwidth of the system and the relevant information is dropped at each Site.

13. Wireless network according to claim 1, wherein the Sites are arranged in succession and which comprises protection links connecting all of the Sites successively, and working links connecting the main Hub to all of the Sites.

14. Wireless network according to claim 1, wherein the Sites are arranged in succession and which comprises protection links connecting all of said Sites successively and working links connected to the main Hub for the first and last Site in the succession.

15. Wireless network according to claim 14, further comprising add/drop type communication.

16. Wireless network according to claim 1, further comprising an ISDN link between the Hub and at least one of the Sites.

17. Wireless network according to claim 16, wherein the ISDN link is an existing narrow band leased line link.

18. Wireless communication system comprising a plurality of networks according to claim 1, and means for interconnecting them.

19. System according to claim 18, wherein the means for interconnecting the networks comprise protection links between Sites of different networks.

20. System according to claim 13, comprising means for using the extra capacity of one network in case of crisis in the Hub of another network.

21. Multipoint fixed wireless network, comprising a central Hub location, connected in a star configuration to satellite locations.

22. Wireless network according to claim 21, wherein the Hub is a BSC and the satellite locations are BTS.

23. Wireless network according to claim 22, having an architecture chosen from among combined omni, combined star, star, urban star and urban ring.

24. Wireless network, substantially as described and illustrated.

25. Method of operating a survivable wireless network according to claim 1, comprising sending information over both working and protection paths and selecting at each Site the best available path.

26. Method of operating a survivable wireless network according to claim 1, comprising sending the main information over the working path, using the protection path to carry extras traffic, and selecting at each Site the best available path, and in case of failure, sending the main information over the protected path, while losing the extra traffic.

27. Method of operating a ring wireless network, comprising sending information constantly in the two opposite directions and selecting at each Site the path that is best at the moment the information is received.

28. Method according to claim 27, comprising sending the information by the full bandwidth of the system and dropping the relevant information at each Site.

29. Method of operating a survivable wireless network, substantially as described and illustrated.

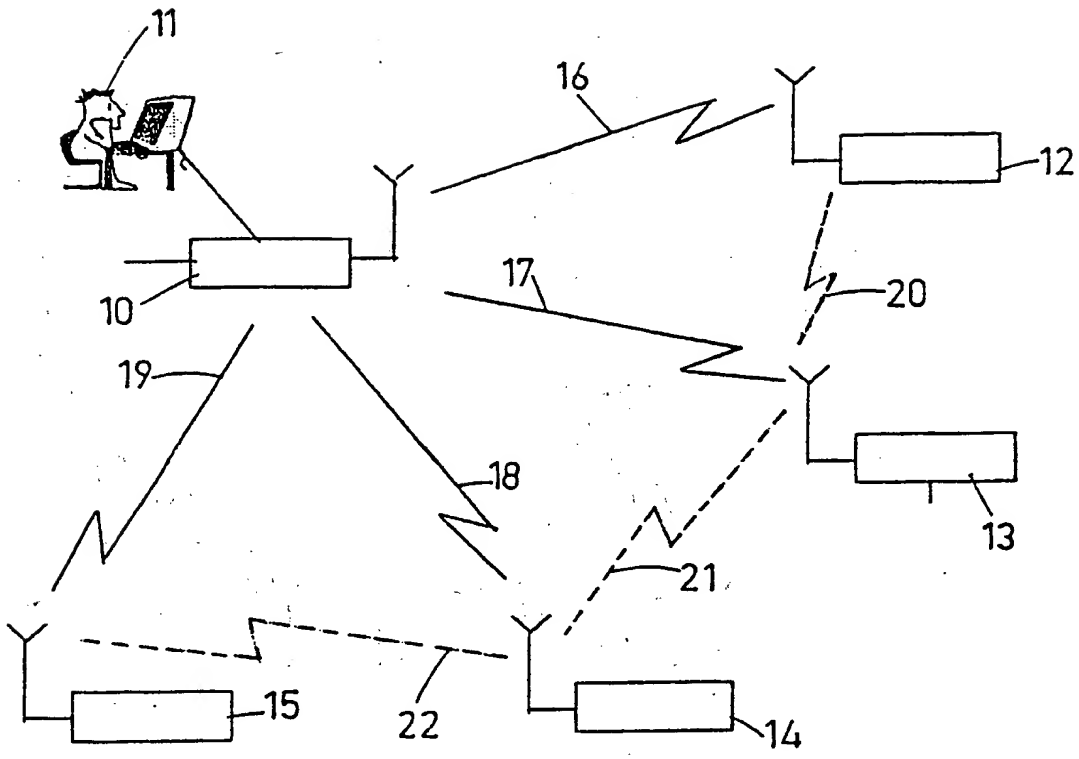

Fig. 1

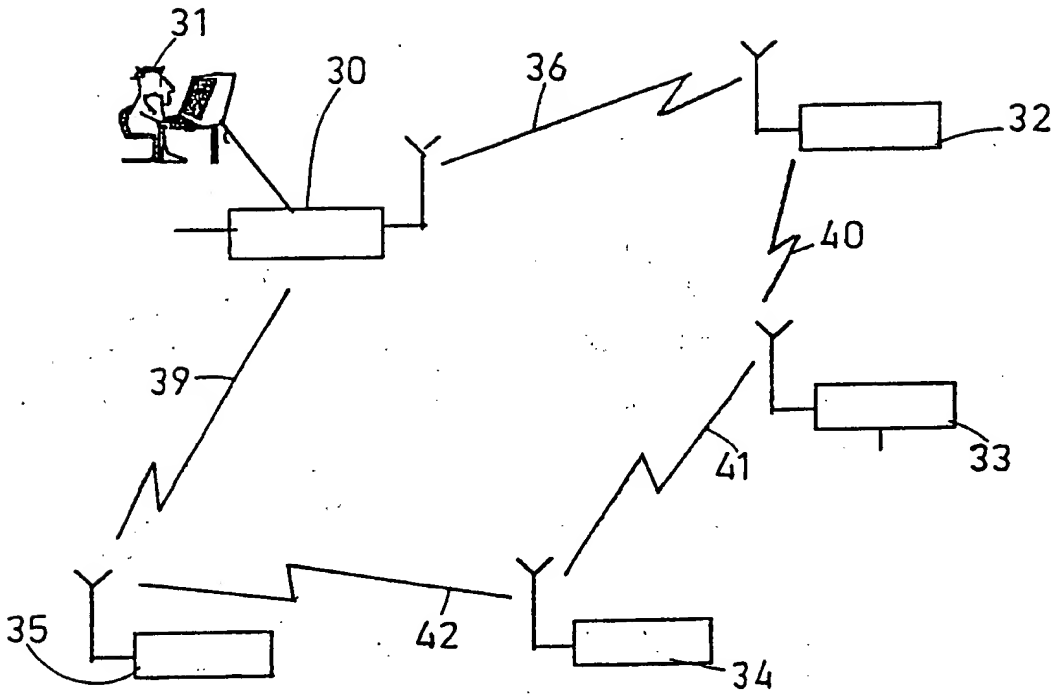

Fig. 2

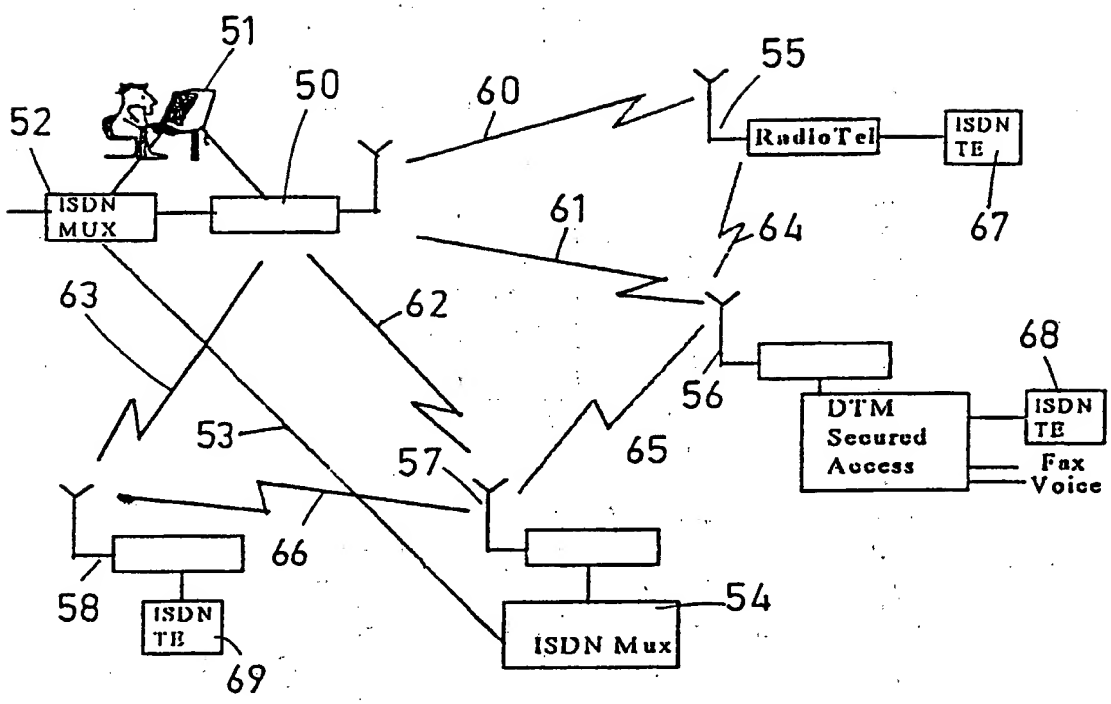
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Fig. 3

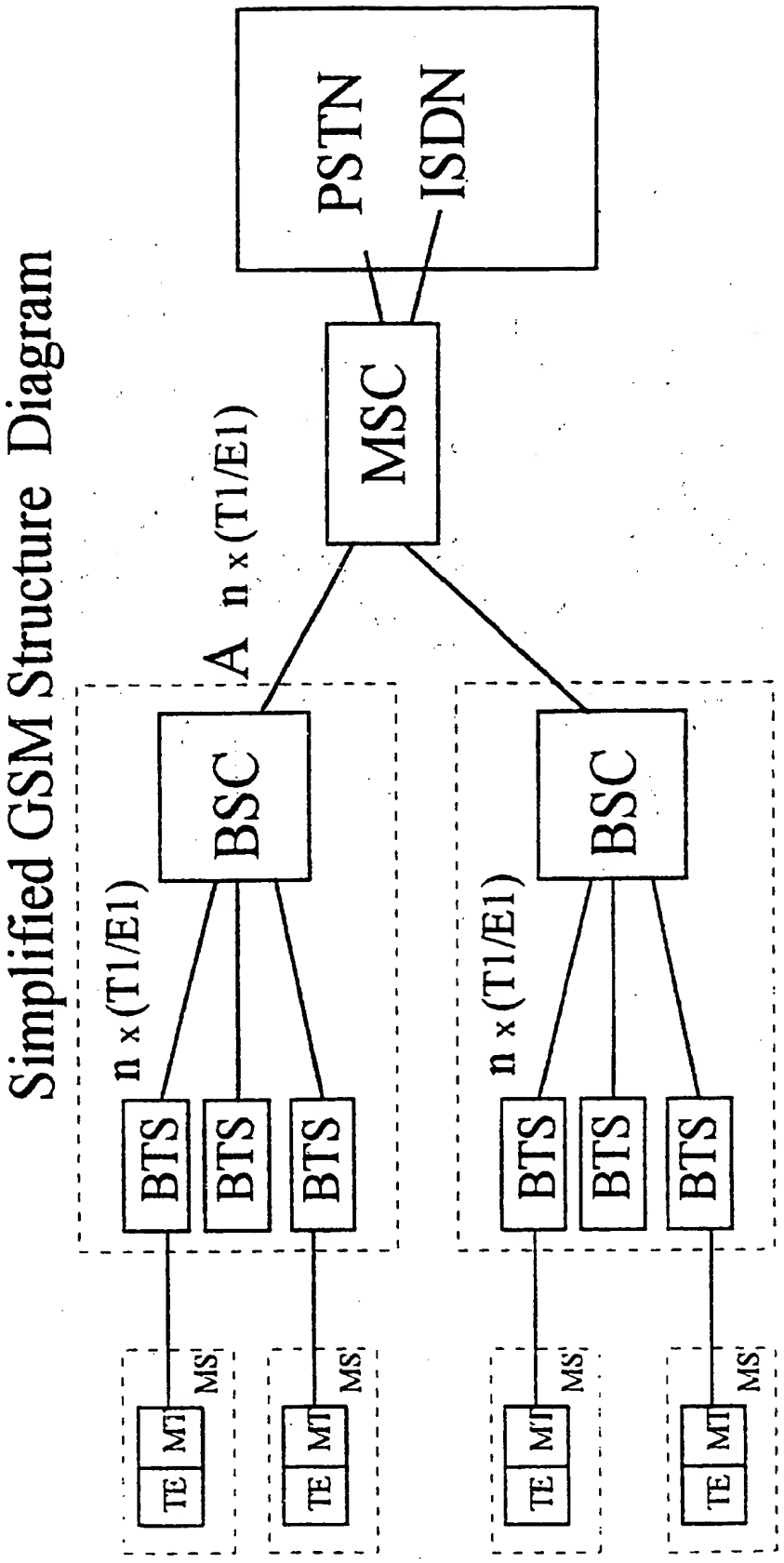
Simplified GSM Structure Diagram
PSTN
ISDN
MSC
A
n x (T1/E1)
BSC
BSC
n x (T1/E1)
n x (T1/E1)
BTS
BTS
BTS
BTS
BTS
BTS
MS
MT
TE
MS
MT
TE
MS
MT
TE
MS
MT
TE

Fig. 4

The defined Network Architecture for the GSM are the following :

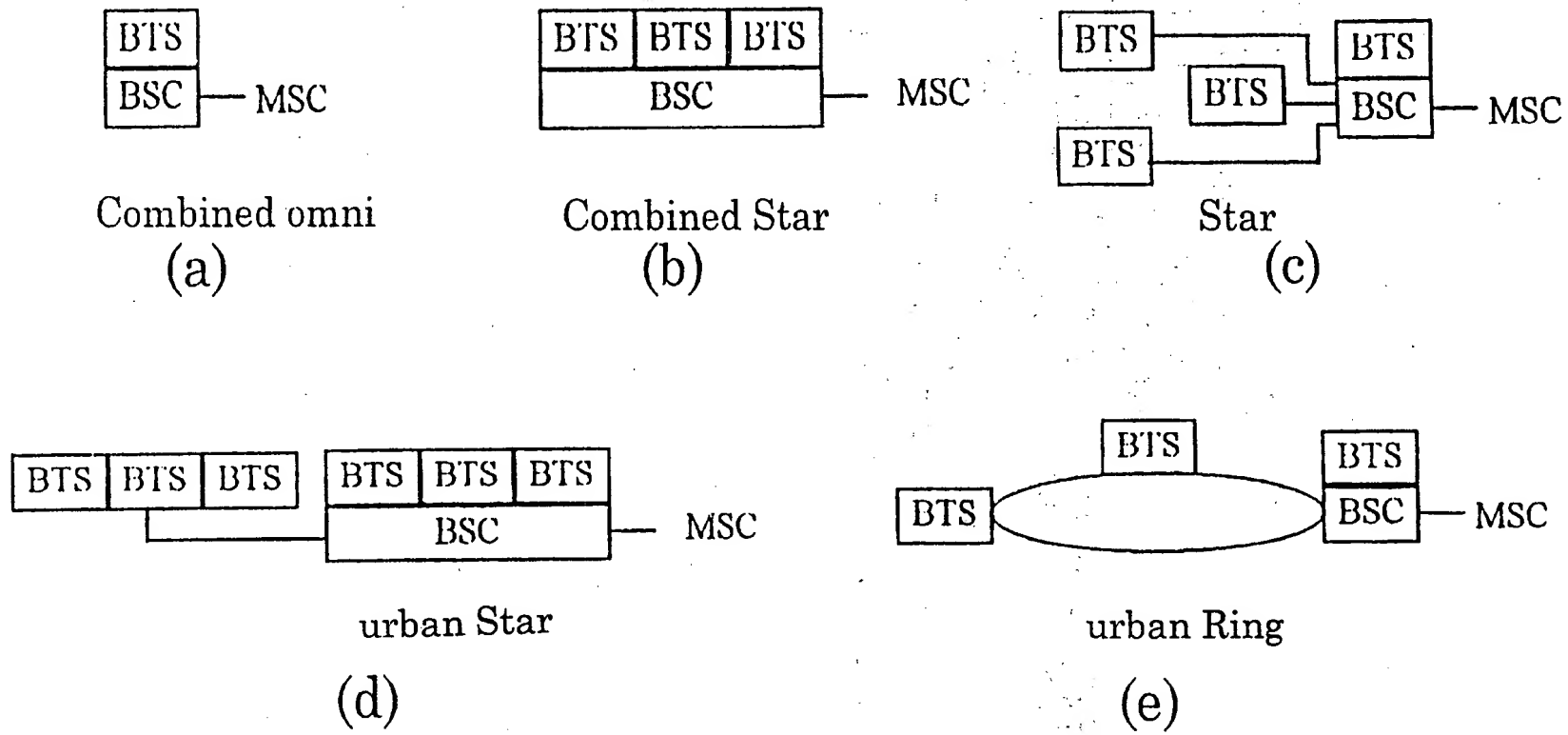

Fig. 5

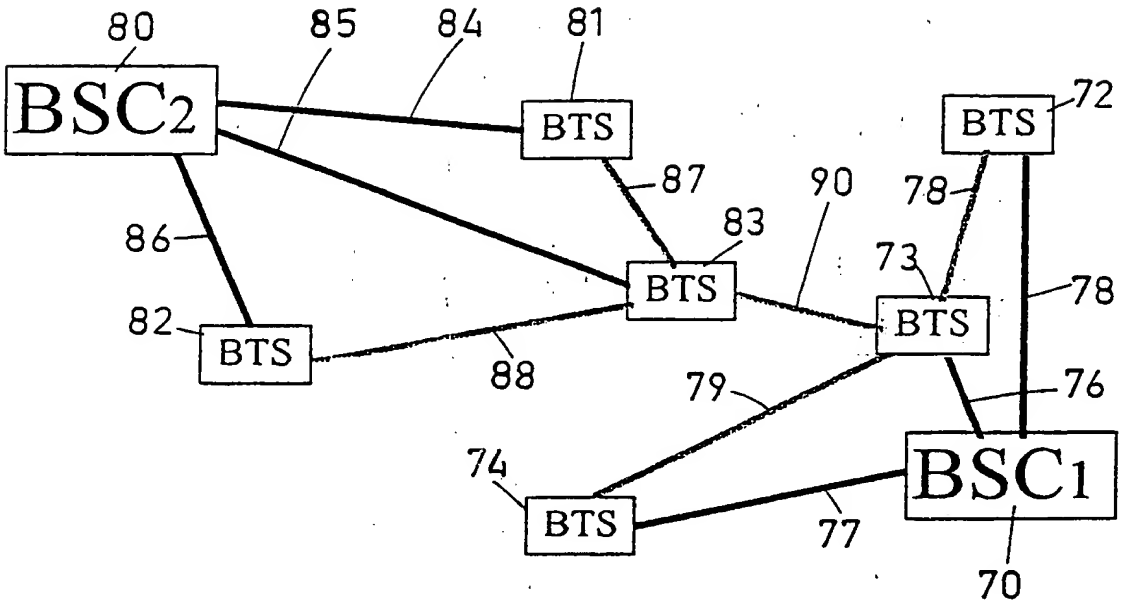

Fig. 6

INTERNATIONAL SEARCH REPORT

Inter. onal Application No
PCT/IL 98/00636

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04Q7/36 H04L12/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04Q H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 097, no. 006, 30 June 1997 & JP 09 051573 A (IWATSU ELECTRIC CO LTD), 18 February 1997	1,3-6,8, 14
A	see abstract see the whole document ---	2,7, 9-13, 15-20, 25-28
A	WO 93 07684 A (SIXTEL SPA) 15 April 1993 see abstract see page 5, line 9 - page 8, line 6 see figure 1 --- -/--	1-20, 25-28

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 April 1999	26/04/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Rabe, M

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INTERNATIONAL SEARCH REPORT

Inter. ...nal Application No
PCT/IL 98/00636

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 276 703 A (BUDIN DAN ET AL) 4 January 1994	21
A	see abstract see column 6, line 47 - line 58 see figure 1	22,23
A	WO 96 26617 A (NOKIA TELECOMMUNICATIONS OY ;LAATU JUHO (FI)) 29 August 1996 see abstract see figure 1	1-23, 25-28
A	US 5 699 409 A (KOJIMA SUSUMU) 16 December 1997 see abstract	1-23, 25-28

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter. ...nal Application No
PCT/IL 98/00636

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